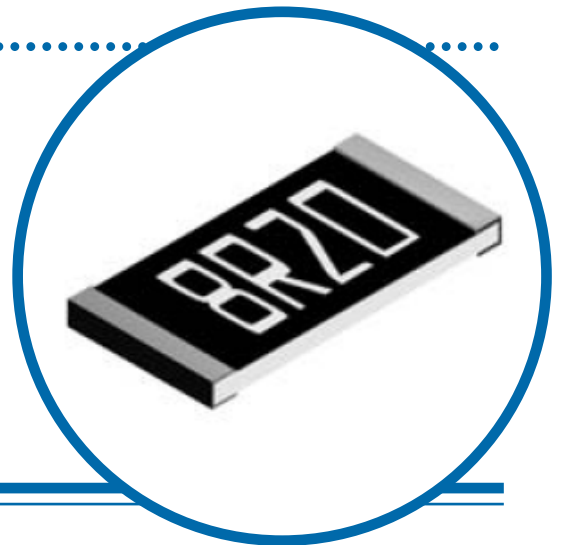


# Precision Surface Mount Resistors

## PCF Series

- Precision metal film technology
- Extended ohmic range 1R - 3M
- Precision to  $\pm 0.01\%$  and 5ppm/ $^{\circ}\text{C}$
- TCR grades 50, 25, 15, 10, 5ppm/ $^{\circ}\text{C}$
- Passivated range for superior humidity performance  
Load life stability and humidity to 0.05%



## Electrical Data - Standard Range

| Type    | TCR<br>(ppm/°C) | Power<br>(W) | Limiting Element<br>Voltage (V) | Ohmic Value Range*    |       |                       |           |           |
|---------|-----------------|--------------|---------------------------------|-----------------------|-------|-----------------------|-----------|-----------|
|         |                 |              |                                 | 0.5%                  | 0.25% | 0.1%                  | 0.05%     | 0.01%     |
| PCF0201 | 50              | 0.031        | 15                              | 49R9-33K <sup>1</sup> | -     |                       |           |           |
|         | 25              |              |                                 | 49R9-5K <sup>1</sup>  |       |                       |           |           |
| PCF0402 | 50              | 0.063        | 25                              | 10R-205K              |       |                       | -         |           |
|         | 25              |              |                                 |                       |       |                       |           |           |
|         | 15              |              |                                 | -                     |       |                       | 49R9-33K  |           |
|         | 10              |              |                                 |                       |       |                       | 49R9-12K  |           |
|         | 5               |              |                                 |                       |       |                       | 49R9-5K   |           |
| PCF0603 | 50              | 0.063        | 50                              | 2R-1M                 |       | 4R7-1M                | -         |           |
|         | 25              |              |                                 |                       |       | 4R7-332K              |           |           |
|         | 15              |              |                                 | -                     |       | 4R7-332K              | 24R9-100K |           |
|         | 10              |              |                                 |                       |       |                       |           |           |
|         | 5               |              |                                 |                       |       | 24R9-15K              |           |           |
| PCF0805 | 50              | 0.1          | 100                             | 1R-2M                 |       | 4R7-2M                | -         |           |
|         | 25              |              |                                 |                       |       | 4R7-511K              |           |           |
|         | 15              |              |                                 | -                     |       | 4R7-511K              | 24R9-200K |           |
|         | 10              |              |                                 |                       |       |                       |           |           |
|         | 5               |              |                                 |                       |       | 24R9-30K <sup>2</sup> |           | 24R9-30K  |
| PCF1206 | 50              | 0.125        | 150                             | 1R-2M5                |       | 4R7-2M5               | -         |           |
|         | 25              |              |                                 |                       |       | 4R7-511K              |           |           |
|         | 15              |              |                                 | -                     |       | 4R7-1M                | 24R9-500K |           |
|         | 10              |              |                                 |                       |       |                       |           |           |
|         | 5               |              |                                 |                       |       | 24R9-50K <sup>2</sup> |           | 24R9-50K  |
| PCF1210 | 50              | 0.2          | 150                             | 1R-2M5                |       | 4R7-2M5               | -         |           |
|         | 25              |              |                                 |                       |       | 4R7-1M                |           |           |
|         | 15              |              |                                 | -                     |       | 4R7-1M                |           | 24R9-500K |
|         | 10              |              |                                 |                       |       |                       |           |           |
|         | 5               |              |                                 |                       |       | 24R9-50K <sup>2</sup> |           | 24R9-50K  |
| PCF2010 | 50              | 0.25         | 150                             | 1R-3M                 |       | 4R7-3M                | -         |           |
|         | 25              |              |                                 |                       |       | 4R7-1M                |           |           |
|         | 15              |              |                                 | -                     |       | 4R7-1M                | 24R9-500K |           |
|         | 10              |              |                                 |                       |       |                       |           |           |
|         | 5               |              |                                 |                       |       | 24R9-100K             |           |           |
| PCF2512 | 50              | 0.5          | 150                             | 1R-3M                 |       | 4R7-3M                | -         |           |
|         | 25              |              |                                 |                       |       | 4R7-1M                |           |           |
|         | 15              |              |                                 | -                     |       | 4R7-1M                | 24R9-500K |           |
|         | 10              |              |                                 |                       |       |                       |           |           |
|         | 5               |              |                                 |                       |       | 24R9-100K             |           |           |

\* Standard values E24 or E96. Other values may be available by request.

Note 1: PCF0201 also available in 1% tolerance. Note 2: Higher values available on request.

### General Note

Welwyn Components reserves the right to make changes in product specification without notice or liability. All information is subject to Welwyn's own data and is considered accurate at time of going to print.

## Electrical Data - High Power Range

| Type     | TCR<br>(ppm/°C) | Power<br>(W) | Limiting<br>Element<br>Voltage (V) | Ohmic Value Range * |       |        |          |           |
|----------|-----------------|--------------|------------------------------------|---------------------|-------|--------|----------|-----------|
|          |                 |              |                                    | 0.5%                | 0.25% | 0.1%   | 0.05%    | 0.01%     |
| PCF0603H | 50              | 0.1          | 75                                 | 4R7-1M              |       |        | 4R7-332K | 24R9-100K |
|          | 25              |              |                                    |                     |       |        |          |           |
|          | 15              |              |                                    | 4R7-332K            |       |        |          |           |
|          | 10              |              |                                    |                     |       |        |          |           |
|          | 5               |              |                                    | 24R9-15K            |       |        |          |           |
| PCF0805H | 50              | 0.125        | 150                                | 1R-1M               |       | 4R7-1M | 4R7-511K | 24R9-200K |
|          | 25              |              |                                    |                     |       |        |          |           |
|          | 15              |              |                                    | 4R7-1M              |       |        |          |           |
|          | 10              |              |                                    | 4R7-511K            |       |        |          |           |
|          | 5               |              |                                    | 24R9-30K            |       |        |          |           |
| PCF1206H | 50              | 0.25         | 200                                | 4R7-1M              |       |        |          | 24R9-500K |
|          | 25              |              |                                    |                     |       |        |          |           |
|          | 15              |              |                                    |                     |       |        |          |           |
|          | 10              |              |                                    |                     |       |        |          |           |
|          | 5               |              |                                    | 24R9-50K            |       |        |          |           |
| PCF1210H | 50              | 0.33         | 200                                | 4R7-1M              |       |        |          | 24R9-500K |
|          | 25              |              |                                    |                     |       |        |          |           |
|          | 15              |              |                                    |                     |       |        |          |           |
|          | 10              |              |                                    |                     |       |        |          |           |
|          | 5               |              |                                    | 24R9-50K            |       |        |          |           |
| PCF2010H | 50              | 0.33         | 200                                | 4R7-1M              |       |        |          | 24R9-500K |
|          | 25              |              |                                    |                     |       |        |          |           |
|          | 15              |              |                                    |                     |       |        |          |           |
|          | 10              |              |                                    |                     |       |        |          |           |
|          | 5               |              |                                    | 24R9-50K            |       |        |          |           |
| PCF2512H | 50              | 0.75         | 200                                | 1R-2K               |       |        | 4R7-2K   | 24R9-2K   |
|          | 25              |              |                                    |                     |       |        |          |           |
|          | 15              |              |                                    |                     |       |        |          |           |
|          | 10              |              |                                    |                     |       |        |          |           |
|          | 5               |              |                                    |                     |       |        |          |           |

\* Standard values E24 or E96. Other values may be available by request.

## Electrical Data - Extended High Power Range

| Type     | TCR<br>(ppm/°C) | Power<br>(W) | Limiting<br>Element<br>Voltage (V) | Ohmic Value Range * |       |          |       |       |
|----------|-----------------|--------------|------------------------------------|---------------------|-------|----------|-------|-------|
|          |                 |              |                                    | 0.5%                | 0.25% | 0.1%     | 0.05% | 0.01% |
| PCF0603X | 50              | 0.166        | 100                                | 10R-332K            |       |          |       |       |
| PCF0805X | 50              | 0.25         | 150                                | 10R-500K            |       |          |       |       |
| PCF1206X | 50              | 0.333        | 200                                | 10R-1M              |       |          |       |       |
| PCF2512X | 50              | 1            | 200                                | 1R-100R             |       | 4R7-100R |       |       |

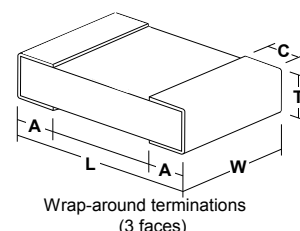
## Electrical Data - Passivated Range

| Type     | TCR<br>(ppm/°C) | Power<br>(W) | Limiting Element<br>Voltage (V) | Ohmic Value Range * |       |      |       |       |
|----------|-----------------|--------------|---------------------------------|---------------------|-------|------|-------|-------|
|          |                 |              |                                 | 0.5%                | 0.25% | 0.1% | 0.05% | 0.01% |
| PCF0402P | 50              | 0.063        | 25                              | 25R-25K             |       |      |       |       |
|          | 25              |              |                                 | 49R9-12K            |       |      |       |       |
|          | 15              |              |                                 | 25R-332K            |       |      |       |       |
| PCF0603P | 50              | 0.063        | 50                              | 25R-100K            |       |      |       |       |
|          | 25              |              |                                 | 10R-800K            |       |      |       |       |
|          | 15              |              |                                 | 25R-200K            |       |      |       |       |
| PCF0805P | 50              | 0.1          | 100                             | 10R-1M              |       |      |       |       |
|          | 25              |              |                                 | 25R-500K            |       |      |       |       |
|          | 15              |              |                                 | 10R-1M              |       |      |       |       |
| PCF1206P | 50              | 0.125        | 150                             | 25R-500K            |       |      |       |       |
|          | 25              |              |                                 | 10R-1M              |       |      |       |       |
|          | 15              |              |                                 | 25R-500K            |       |      |       |       |
| PCF2010P | 50              | 0.25         | 150                             | 10R-1M              |       |      |       |       |
|          | 25              |              |                                 | 25R-500K            |       |      |       |       |
|          | 15              |              |                                 | 10R-1M              |       |      |       |       |
| PCF2512P | 50              | 0.5          | 150                             | 10R-1M              |       |      |       |       |
|          | 25              |              |                                 | 10R-1M              |       |      |       |       |
|          | 15              |              |                                 | 10R-1M              |       |      |       |       |

\* Standard values E24 or E96. Other values may be available by request.

## Physical Data

| Dimensions (mm) and Weight |             |             |       |             |             |    |
|----------------------------|-------------|-------------|-------|-------------|-------------|----|
|                            | L           | W           | T max | A           | C           | Wt |
| 0201                       | 0.58 ± 0.05 | 0.29 ± 0.05 | 0.26  | 0.15 ± 0.05 | 0.12 ± 0.05 | 1  |
| 0402                       | 1.0 ± 0.05  | 0.5 ± 0.05  | 0.40  | 0.2 ± 0.1   | 0.2 ± 0.1   | 3  |
| 0603                       | 1.6 ± 0.2   | 0.8 ± 0.2   | 0.55  | 0.3 ± 0.2   | 0.3 ± 0.2   | 6  |
| 0805                       | 2.0 ± 0.2   | 1.25 ± 0.2  | 0.65  | 0.4 ± 0.25  | 0.3 ± 0.2   | 9  |
| 1206                       | 3.05 ± 0.15 | 1.55 ± 0.15 | 0.65  | 0.35 ± 0.25 | 0.42 ± 0.2  | 20 |
| 1210                       | 3.10 ± 0.15 | 2.4 ± 0.15  | 0.50  | 0.55 ± 0.25 | 0.4 ± 0.2   | 25 |
| 2010                       | 4.9 ± 0.2   | 2.4 ± 0.2   | 0.65  | 0.5 ± 0.25  | 0.6 ± 0.3   | 36 |
| 2512                       | 6.3 ± 0.2   | 3.1 ± 0.2   | 0.65  | 0.5 ± 0.25  | 0.6 ± 0.3   | 55 |



### Construction

A thin-film material is selectively deposited on a 96% alumina substrate together with metallic contacts at each end of the resistor. The unadjusted resistors are heat treated to give the required TCR and stability, then a precisely controlled laser trim process adjusts the resistance value. Epoxy protection is applied and wrap-around terminations are added and plated with Nickel then Tin. Each resistor is measured immediately before packing into tape.

### Terminations

The chips are supplied with 100% Sn matte plated wrap-around terminations suitable for soldering.

## Performance Data - Standard Range

| Test Parameters            | Conditions                                | Maximum change (+0.05R)          |                   |                                 |
|----------------------------|-------------------------------------------|----------------------------------|-------------------|---------------------------------|
|                            |                                           | ≥0.05% tolerance<br>0603 to 2512 | Chip size<br>0402 | 0.01% tolerance<br>0603 to 2512 |
| Load life                  | 1000 hours rated load @ 70°C              | 0.25%                            | 0.5%              | 0.05%                           |
| Humidity                   | 1000 hours @ 40°C, 90 - 95%RH             | 0.3%                             | 0.3%              | 0.05%                           |
| Short term overload        | 6.25 x rated Power, or 2 x LEV, for 5 sec | 0.5%                             | 0.5%              | 0.05%                           |
| High temperature operation | 1000 hours at 125°C                       | 0.25%                            | 0.25%             | 0.25%                           |
| Temperature cycle          | 5 cycles -55°C, 125°C                     | 0.1%                             | 0.1%              | 0.05%                           |
| Resistance to solder heat  | 270°C, 10 sec                             | 0.2%                             | 0.2%              | 0.05%                           |
| Solderability              | 235°C, 2 sec                              | 95% minimum coverage             |                   |                                 |

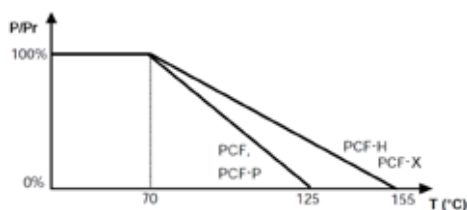
## Performance Data - High Power Range/Extended High Power Range

| Test Parameters            | Conditions                                | Maximum change (+0.05R) |                 |
|----------------------------|-------------------------------------------|-------------------------|-----------------|
|                            |                                           | 0.5%                    | 0.01% tolerance |
| Load life                  | 1000 hours rated load @ 70°C              | 0.5%                    | 0.05%           |
| Humidity                   | 1000hrs @ 40°C, 90 - 95%RH                | 0.5%                    | 0.05%           |
| Short term overload        | 6.25 x rated Power, or 2 x LEV, for 5 sec | 0.5%                    | 0.05%           |
| High temperature operation | 1000 hours at 155°C                       | 0.5%                    | 0.25%           |
| Temperature cycle          | 5 cycles -55°C, 150°C                     | 0.25%                   | 0.1%            |
| Resistance to solder heat  | 270°C, 10 sec                             | 0.2%                    | 0.05%           |
| Solderability              | 235°C, 2 sec                              | 95% minimum coverage    |                 |

## Performance Data - Passivated Range

| Test Parameters            | Conditions                                | Maximum change (+0.05R) |       |
|----------------------------|-------------------------------------------|-------------------------|-------|
|                            |                                           | 0603 to 2512            | 0402  |
| Load life                  | 1000 hours rated load @ 70°C              | 0.05%                   | 0.25% |
| Humidity                   | 1000hrs @ 40°C, 90 - 95%RH                | 0.05%                   | 0.5%  |
| Short term overload        | 6.25 x rated Power, or 2 x LEV, for 5 sec | 0.02%                   | 0.1%  |
| High temperature operation | 1000 hours at 125°C                       | 0.05%                   | 0.5%  |
| Temperature cycle          | 5 cycles -55°C, 125°C                     | 0.02%                   | 0.1%  |
| Resistance to solder heat  | 270°C, 10 sec                             | 0.02%                   | 0.1%  |
| Solderability              | 235°C, 2 sec                              | 95% minimum coverage    |       |

### Derating Curve



### Solderability

The terminations have an electroplated nickel barrier and tin coating. This ensures excellent 'leach' resistance properties and solderability.

### Packaging

PCF Resistors are supplied taped and reeled as per IEC 286-3.

### Application Notes

PCF resistors are ideally suited for handling by automatic methods due to their rectangular shape and the small dimensional tolerances. Electrical connection to a ceramic substrate or to a printed circuit board can be made by reflow or wave soldering of wrap-around terminations.

Wrap-around terminations provide good leach properties and ensure reliable contact. Due to the robust construction, the PCF can be immersed in the solder bath for 30 seconds at 260 °C. This enables the resistor to be mounted on one side of a printed circuit board and wire-leaded components applied on the other side.

PCF resistors themselves can operate at a maximum temperature of 125 °C (see performance above) (155 °C for High Power grades). For soldered resistors, the joint temperature should not exceed 110 °C. This condition is met when the stated power levels at 70 °C are used.

## Ordering Procedure

Example: PCF0603 at 1.54 kilohms 0.1% and 15ppm/°C taped on a reel of 5000 pieces:

|                                         |                                                                                                                                                                                                                       |             |             |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|---------------|----------|----------|----|----------|---|------------|----|----------------|----|------------|----|----------|--|--|
| <b>Type</b>                             | <b>PCF</b>                                                                                                                                                                                                            | <b>0603</b> | <b>- 11</b> | <b>- 1K54</b> | <b>B</b> | <b>I</b> |    |          |   |            |    |                |    |            |    |          |  |  |
| <b>Size</b>                             |                                                                                                                                                                                                                       |             |             |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
| <b>Range</b>                            |                                                                                                                                                                                                                       |             |             |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
|                                         | <table border="1"> <tr><td></td><td>Standard</td></tr> <tr><td>H</td><td>High Power</td></tr> <tr><td>X</td><td>Extended Power</td></tr> <tr><td>P</td><td>Passivated</td></tr> </table>                              |             |             |               |          |          |    | Standard | H | High Power | X  | Extended Power | P  | Passivated |    |          |  |  |
|                                         | Standard                                                                                                                                                                                                              |             |             |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
| H                                       | High Power                                                                                                                                                                                                            |             |             |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
| X                                       | Extended Power                                                                                                                                                                                                        |             |             |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
| P                                       | Passivated                                                                                                                                                                                                            |             |             |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
| <b>TCR</b>                              | <table border="1"> <tr><td>13</td><td>5ppm/°C</td><td>R</td><td>25ppm/°C</td></tr> <tr><td>12</td><td>10ppm/°C</td><td>02</td><td>50ppm/°C</td></tr> <tr><td>11</td><td>15ppm/°C</td><td></td><td></td></tr> </table> |             |             |               |          |          | 13 | 5ppm/°C  | R | 25ppm/°C   | 12 | 10ppm/°C       | 02 | 50ppm/°C   | 11 | 15ppm/°C |  |  |
| 13                                      | 5ppm/°C                                                                                                                                                                                                               | R           | 25ppm/°C    |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
| 12                                      | 10ppm/°C                                                                                                                                                                                                              | 02          | 50ppm/°C    |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
| 11                                      | 15ppm/°C                                                                                                                                                                                                              |             |             |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
| <b>Resistance value</b><br>(IEC62 Code) |                                                                                                                                                                                                                       |             |             |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
| <b>Tolerance</b>                        | <table border="1"> <tr><td>L</td><td>0.01%</td><td>C</td><td>0.25%</td></tr> <tr><td>W</td><td>0.05%</td><td>D</td><td>0.5%</td></tr> <tr><td>B</td><td>0.1%</td><td></td><td></td></tr> </table>                     |             |             |               |          |          | L  | 0.01%    | C | 0.25%      | W  | 0.05%          | D  | 0.5%       | B  | 0.1%     |  |  |
| L                                       | 0.01%                                                                                                                                                                                                                 | C           | 0.25%       |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
| W                                       | 0.05%                                                                                                                                                                                                                 | D           | 0.5%        |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |
| B                                       | 0.1%                                                                                                                                                                                                                  |             |             |               |          |          |    |          |   |            |    |                |    |            |    |          |  |  |

### Packing

|    |                                    |             |                                                            |
|----|------------------------------------|-------------|------------------------------------------------------------|
| I  | 0201, 0402                         | 10,000/reel | Standard                                                   |
|    | 0603, 0805, 1206, 1210             | 5000/reel   |                                                            |
|    | 2010, 2512                         | 4000/reel   |                                                            |
|    |                                    |             |                                                            |
| T1 | 0402, 0603, 0805, 1206, 2010, 2512 | 1000/reel   | Please enquire to confirm availability of 1000 piece reels |